

What is claimed is:

1. An apparatus for supporting a tool relative to a surface of a workpiece, the apparatus comprising:

a base adapted to be attached to the workpiece;

a tool support coupled to the base and moveable along a translation axis relative to the workpiece;; and

a biasing device operatively coupled to at least one of the base and the tool support, the biasing device being adapted to at least partially counterbalance a force exerted on the tool support along the translation axis.

2. The apparatus of Claim 1, wherein the translation axis has at least a component that is perpendicular to a local normal to the surface of the workpiece.

3. The apparatus of Claim 1, wherein the tool support is slideably coupled to the base along a guide rail.

4. The apparatus of Claim 1, wherein the tool support is moveable in first and second directions along the translation axis.

5. The apparatus of Claim 1, wherein the biasing device includes a pneumatic actuator.

6. The apparatus of Claim 1, wherein the biasing device includes a motor.

7. The apparatus of Claim 1, wherein the biasing device includes a constant torque motor.

8. The apparatus of Claim 1, wherein the biasing axis is aligned with the translation axis.

9. The apparatus of Claim 1, wherein the biasing device is controllably biasable in a biasing direction along the biasing axis.

10. The apparatus of Claim 1, wherein the base includes:

at least one elongated rail member coupleable to the surface of the workpiece; and



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a carriage assembly moveably coupled to the at least one rail member, the tool support being coupled to the carriage assembly.

11. The apparatus of Claim 10, wherein the translation direction is at least partially transverse to the at least one elongated rail member.

12. The apparatus of Claim 10, wherein the carriage assembly includes a drive assembly having a drive motor operatively engaging the at least one rail member and adapted to drive the carriage assembly along the at least one rail member.

13. The apparatus of Claim 1, wherein the base includes:
first and second elongate flexible rails, the rails being spaced apart and approximately parallel to each other;
a plurality of vacuum attachment devices connected to each rail and spaced at intervals therealong for releasably attaching each rail to the surface of the workpiece by vacuum; and
a carriage coupled to the tool support and moveably engaging the rails, the carriage being moveable along the rails to position the tool support at various locations relative to the workpiece.

14. An assembly for performing a manufacturing operation on a surface of a workpiece, the assembly comprising:
a base adapted to be attached to the workpiece;
a tool support coupled to the base and moveable along a translation axis relative to the workpiece;
a manufacturing tool coupled to the tool support and adapted to be engageable with the surface of the workpiece to perform the manufacturing operation on the surface of the workpiece; and
a biasing device operatively coupled to at least one of the base and to the tool support, the biasing device being adapted to at least partially counterbalance a force exerted on the tool support along the translation axis.



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15. The assembly of Claim 14, wherein the translation axis has at least one component that is perpendicular to a local normal to the surface of the workpiece.

16. The apparatus of Claim 14, wherein the tool support is slideably coupled to the base
5 along a guide rail.

17. The apparatus of Claim 14, wherein the tool support is moveable in first and second directions along the translation axis.

18. The apparatus of Claim 14, wherein the biasing device includes a pneumatic
10 actuator.

19. The apparatus of Claim 14, wherein the biasing device includes a motor.

20. The apparatus of Claim 14, wherein the biasing device includes a constant torque
15 motor.

21. The apparatus of Claim 14, wherein the biasing axis is aligned with the translation
axis.
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22. The apparatus of Claim 14, wherein the biasing device is controllably biasable in a
biasing direction along the biasing axis.

23. The apparatus of Claim 14, wherein the base includes:
25 at least one elongated rail member coupleable to the surface of the workpiece; and
a carriage assembly moveably coupled to the at least one rail member, the tool
support being coupled to the carriage assembly.

24. The apparatus of Claim 23, wherein the translation direction is at least partially
30 transverse to the at least one elongated rail member.

25. The apparatus of Claim 23, wherein the carriage assembly includes a drive
assembly having a drive motor operatively engaging the at least one rail member and adapted
to drive the carriage assembly along the at least one rail member.
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26. The assembly of Claim 14, wherein the base includes:

first and second elongate flexible rails, the rails being spaced apart and approximately parallel to each other;

5 a plurality of vacuum attachment devices connected to each rail and spaced at intervals therealong for releasably attaching each rail to the surface of the workpiece by vacuum; and

a carriage coupled to the tool support and moveably engaging the rails, the carriage being moveable along the rails to position the tool support at various locations relative to the workpiece.

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27. The assembly of Claim 14, wherein the manufacturing tool includes a drill and the manufacturing operation includes a drilling operation.

28. A method of performing a manufacturing operation on a surface of a workpiece, the method comprising:

15 moveably supporting a manufacturing tool proximate a surface of the workpiece, the manufacturing tool being moveable along a translation direction over the surface of the workpiece; and

providing a biasing force in a biasing direction using a biasing device, the biasing direction being substantially parallel to the translation direction.

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29. The method of Claim 28, wherein moveably supporting a manufacturing tool proximate a surface of the workpiece includes slideably supporting the manufacturing tool on a guide rail positioned proximate the surface of the workpiece, the manufacturing tool being moveable in a first translation direction along the guide rail, and also in a second translation
25 direction opposingly oriented to the first translation direction.

30. The method of Claim 28, wherein providing a biasing force in a biasing direction using a biasing device includes providing a biasing force that is adapted to counterbalance a force exerted on the manufacturing tool along the translation direction.

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31. The method of Claim 30, wherein providing a biasing force that is adapted to counterbalance a force exerted on the manufacturing tool includes providing a biasing force that is adapted to counterbalance a gravitational force exerted on the manufacturing tool.



32. The method of Claim 28, wherein providing a biasing force in a biasing direction using a biasing device includes providing a biasing force that is oriented opposite to the translation direction.

5 33. The method of Claim 28, wherein providing a biasing force in a biasing direction using a biasing device includes providing a biasing force in a biasing direction using a biasing cylinder.

10 34. The method of Claim 28, wherein providing a biasing force in a biasing direction using a biasing device includes providing a biasing force in a biasing direction using a motor.

35. The method of Claim 28, further comprising moving the manufacturing tool along the translation direction.

15 36. The method of Claim 28, further comprising performing the manufacturing operation with the manufacturing tool on the surface of the workpiece.

37. The method of Claim 36, wherein the manufacturing tool includes a drill and the manufacturing operation includes a drilling operation.

20 38. A method of performing a manufacturing operation on a surface of a workpiece, the method comprising:

detachably securing a support member to the surface of the workpiece;
moveably attaching a manufacturing tool to the support member, the manufacturing tool being moveable relative to the support member along a translation
25 direction over the surface of the workpiece;
securely engaging the manufacturing tool with the surface of the workpiece; and
with the manufacturing tool securely engaged with the surface of the workpiece, detaching the support member from the surface of the workpiece; and
with the manufacturing tool securely engaged with the surface of the workpiece,
30 moving the support member relative to the manufacturing tool.

39. The method of Claim 38, wherein detachably securing a support member to the surface of the workpiece includes detachably securing a pair of elongated rail members to the surface of the workpiece.



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40. The method of Claim 38, wherein detachably securing a support member to the surface of the workpiece includes providing a vacuum to a vacuum assembly to detachably secure the support member to the surface of the workpiece.

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41. The method of Claim 38, wherein moving the support member relative to the manufacturing tool includes moving the support member along an x-axis relative to the manufacturing tool, the x-axis being approximately perpendicular with the translation direction.

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42. The method of Claim 38, wherein moving the support member relative to the manufacturing tool includes moving the support member along an x-axis relative to the manufacturing tool, the x-axis being approximately perpendicular with the translation direction and with a local normal to the surface of the workpiece.

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